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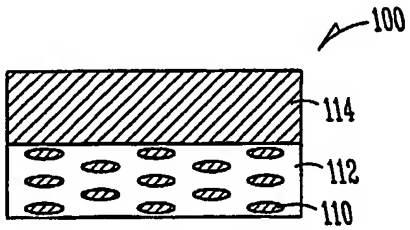
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: MULTI-LAYER POLYMER-SOLDER HYBRID THERMAL INTERFACE MATERIAL FOR INTEGRATED HEAT SPREADER AND METHOD OF MAKING SAME



(57) Abstract: A process of making a multi-layer thermal interface material is depicted. The multi-layer thermal interface material is attached between an integrated heat spreader and a die. Processing of the multi-layer thermal interface material includes stamping or other pressure processing.

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INTERNATIONAL SEARCH REPORT

Internat ...ication No
PCT/US2004/018164

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01L23/373

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 981 085 A (NINOMIYA ET AL) 9 November 1999 (1999-11-09) column 4, line 10 - column 9, line 42; figures 2,8	1,2,5,6, 16,19-21
Y	US 4 782 893 A (THOMAS ET AL) 8 November 1988 (1988-11-08) *see Figure 2 and accompanying description*	1,2, 5-10,16, 18-24
Y	US 2002/135984 A1 (GREENWOOD ALFRED W ET AL) 26 September 2002 (2002-09-26) paragraphs [0036] - [0045], [0051], [0056]; figures 1,4	1,2, 5-10,16, 18-24

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 February 2005	27/05/2005

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Cousins, D

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2004/018164

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 02/091395 A (HONEYWELL INTERNATIONAL INC; NGUYEN, MY) 14 November 2002 (2002-11-14) the whole document -----	1,2, 5-10,16, 18-24

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2004/018164

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1,2,5-10,16,18-24

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1,2,5-10,16,18-24

Claim 1, 2: thermal interface member having a solder preform disposed on a matrix material, insofar as the transition between the solder preform and the matrix is abrupt, the matrix being of a second heat transfer structure, with second heat transfer structures dispersed in the matrix, the second heat transfer structure being a polymer, the first heat transfer structures being of a material alternative to diamond (viz. graphite, inorganic dielectric particles, metal particles). Claims 5 - 10, 16 (insofar as the transition between the solder preform and the matrix is abrupt), 18 - 24.

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2. claims: 1,3,4,16

Claim 1, thermal interface member having a solder preform disposed on a matrix material, insofar as the transition between the solder preform and the matrix is a concentration gradient. Claims 3, 4 directed to a thermal interface member having a solder preform disposed on a matrix material, with a middle heat transfer structure therebetween, the latter having a composition that is transitional between that of the matrix and that of the solder preform. Claim 16 (insofar as the transition between the solder preform and the matrix is a concentration gradient).

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3. claims: 11-15

Claims 11-15: a process of forming a heat transfer composite comprising the steps of:
mixing and casting a matrix comprising a plurality of first heat transfer structures within a second heat transfer structure of a curable material; and bonding the matrix to a solder layer and forming the matrix is by co-extruding and singulating.

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4. claim: 17

Claim 17: Bonding a heat transfer subsystem to a die and a heat spreader at a temperature (Ttim -Tamb)/2.

INTERNATIONAL SEARCH REPORT

Internati... Application No
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